

Further Comparisons of the Random Coefficients Model with Repeated Measures ANOVA in Longitudinal Group-Randomized Trials

August 9, 2021 Joint Statistical Meetings

Jonathan Moyer and David M. Murray

Office of Disease Prevention

Division of Program Coordination, Planning and Strategic Initiatives

National Institutes of Health



National Institutes of Health
Office of Disease Prevention

Introduction

- Group- or cluster-randomized trials (GRTs) randomly assign groups to treatment conditions.
 - Group-level interventions, manipulation of physical or social environment, or cannot be delivered to individuals.
 - Intraclass correlation (ICC) between observations can inflate Type I error rates if not accounted for.
- Multiple-period GRTs further complicate correlational structure by the nature of repeat observations.
 - Cohort: the same individuals measured at each time period.
 - Cross-sectional: individuals measured only once.
- Key analysis decision: time as categorical or continuous?
 - Repeated Measures ANOVA (RM-ANOVA): time is categorical.
 - Random Coefficients (RC): time is continuous.

Updates to guidance for analysis models

- Longstanding guidance recommends the use of RC over RM-ANOVA when analyzing multiple-period GRTs (Murray, et al., 1998).
 - RC maintained nominal Type I error rate with data generated assuming both approaches.
 - RM-ANOVA exhibited inflated Type I error rate with data generated assuming RC.
- Guidance assumed cross-sectional data, variance components covariance structure, and time x group random effects.
- Questions:
 - Would better performance with RM-ANOVA analysis models be achieved with unstructured covariance structure?
 - Would similar patterns have been seen in cohort data?
 - How important is the time x group term in the analytic model if the data generation model includes variability at that level?

Murray DM, et al. Analysis of data from group-randomized trials with repeat observations on the same groups. *Stat Med.* 1998;17(14):1581-600. PMID: 9699231

Overview and Conclusions

- We present results of a simulation study assessing the Type I error rate for RM-ANOVA and RC analysis models under the null hypothesis of no fixed effects.
 - Cross-sectional and cohort data sets generated under RM-ANOVA and RC models were generated.
 - All simulated data sets contained time x group variation.
 - RM-ANOVA analysis models were applied using both variance components and unstructured covariance.
- Key conclusions:
 - RC analysis models with time x group random effects performed well on all data sets.
 - RM-ANOVA with unstructured covariance does not avoid inflated Type I error when applied to data generated according to RC.
 - Analysis models specifying only group-level intercepts performed poorly unless the ICC was very low.